APPENDIX D – *ARSENIC WET SCREENING STUDY*

D.1 Objective and Overview

The objective of performing additional arsenic treatability studies was to better define the distribution of arsenic concentration relative to soil particle size. Distribution data can be used to select a particle size "cut point" for remedial action that corresponds to the cleanup or remediation level for arsenic.

We analyzed soil samples from two areas of the Site, the Narrow Gage Railroad (NGRR) and the 250/500-foot arsenic soil sampling grid (Grid), to determine if the differences in average arsenic concentration are likely to impact the distribution with grain size. We combined the results of the Hart Crowser arsenic treatability studies with the previously performed Hazen arsenic treatability studies to determine the average arsenic concentration associated with different grain sizes.

A total of three Hazen arsenic study analyses were included in this evaluation. Hazen arsenic study results from the Area 36 - Melt Shop and the Area 18 - Hot Spot were incorporated in the evaluation of the Grid soil data. Hazen arsenic study results from the NGRR area were incorporated in the evaluation of the NGRR soil data.

Hart Crowser samples were collected close to locations identified during the RI sampling as areas of elevated arsenic concentrations. The RI sampling concentrations for the Grid and the NGRR, as well as concentrations for the whole sample and the pulverized whole sample from the treatability study, are presented in Table D-1.

The whole sample result represents the analysis of an aliquot of soil from the treatability study samples collected and analyzed using the same procedure used for the RI samples.

The pulverized whole sample result is the concentration in an aliquot of soil from the treatability study following pulverization of the entire soil sample.

D.2 Treatability Sample Collection

A total of ten 5-point composite samples were collected at selected locations that were previously sampled during the RI. Five samples were collected from the NGRR locations to provide samples that contained relatively high concentrations (400 to 950 mg/kg) of arsenic. The remaining five samples were collected from the 250/500-foot RI sampling grid; these were intended to provide treatability study samples containing lower arsenic concentrations (82 to 360 mg/kg). The ten samples were collected using the same procedure. A four-gallon sample was collected from a depth of 0 to 6 inches at each sampling location, using the same sampling procedure as for RI sample collection. Each 5-point composite sample was collected immediately adjacent to the previously sampled RI location. The sample was placed into a clean/lined bucket and appropriately labeled with the same RI sample number as used previously. Table D-1 summarizes the results from the treatability study sample locations and the associated total arsenic concentrations from previous RI analyses.

Several observations can be made by comparison of these data:

- The RI sample results have generally higher arsenic concentrations compared to the treatability study whole sample results.
- The results for the pulverized whole samples are all lower than the results of the non-pulverized whole sample. These results indicate that the higher concentration of arsenic is confined to smaller soil size fractions.

D.3 Treatability Study Procedure

The ten samples were analyzed using the same physical and chemical testing procedures. Physical testing of the samples was performed in the Hart Crowser Physical Laboratory. Chemical analysis for total arsenic was performed at Analytical Technologies, Inc. (ATI) in Renton.

D.3.1 Physical Testing

The following sample preparation and physical testing procedures were performed prior to the total arsenic analysis. Figure D-1 presents a schematic flow diagram of the procedure:

1) Initially, the entire 4-gallon sample was thoroughly mixed to improve homogeneity.

2) The sample was coned and quartered into four portions (approximately 1-gallon each). Three of the quarters were combined into one 3-gallon sieve sample.

3) A 4-oz sample aliquot was collected from the remaining 1-gallon sample and analyzed the aliquot for total arsenic at ATI. This sample is identified as a "whole sample". The remainder of this sample was crushed and pulverized until 50 percent of the sample passed the 100 mesh sieve. A 4-oz aliquot was collected from the pulverized sample and submitted for total arsenic analysis at ATI. This sample is identified as "pulverized whole sample."

4) The whole sample from Step 3 was dried, crushed, and pulverized to 50% passing the 100 mesh sieve.

5) A 4-oz aliquot of the material from Step 4 was collected and submitted to ATI for total arsenic analysis.

6) The 3-gallon sample was dry screened at 10 mesh.

7) The +10 mesh material from Step 6 was wet screened at 10 mesh (-10 mesh to Step 12).

8) The +10 mesh material from Step 7 was dried and sieved with screen sizes of 1", 1/2", 1/4" and 8 mesh.

9) The material retained was then weighed on the 1", 1/2", 1/4" and 8 mesh screens and calculated the >8 mesh percent.

10) After screening and weighing the dried +10 mesh material through 1", 1/2", 1/4", and 8 mesh sieves (Steps 4 and 7) the material retained on each sieve was pulverized so 50 percent of the material was <100 mesh. A 4-oz sample of the pulverized material was collected and sent to ATI for total arsenic analysis.

11) A 4-oz aliquot of each sample was collected and sent to ATI for total arsenic analysis.

12) The -10 mesh material from the wet screening and the -10 mesh from the initial dry screening were combined and dried.

13) The -10 mesh material was weighed for the >8 mesh percent calculation.

14) The -10 mesh material was homogenized and quartered, to produce one 1,000 gram sample aliquot. The remaining sample was held in the original sample container.

15) The 1,000 gram aliquot was wet screened at 200 mesh. (The -200 mesh water and slimes to Step 18). Two samples of the slime water were collected and analyzed for total arsenic (RR-545 and RR-528).

16) The dry +200 mesh material was weighed and then sieved through 16, 30, 60, 100, and 200 mesh sieves.

17) The material retained on these sieves was weighed and the <8 mesh percent was calculated.

18) The material retained on each sieve was pulverized so that at least 50 percent of the sample was <100 mesh. A 4-oz sample of the pulverized material was collected and sent to ATI for total arsenic analysis.

19) A sample of water and slimes from Step 15 was submitted to ATI for total arsenic analysis.

20) The -200 mesh water and slimes from Step 15 were dried and combined the -200 mesh material from Step 15 with the -200 mesh material from Step 16.

21) The dried -200 mesh material was weighed and sampled for total arsenic analysis at ATI.

The above procedures were followed for each of the samples. However, in two cases, modifications occurred during the analysis as noted below.

- Step 18 was not implemented as described above for sample RR-546. The temperature in the oven used to dry the -200 mesh samples from Step 13 was inadvertently increased to 430°C. Typical oven temperatures were approximately 80°C. The higher temperature may have reduced the total arsenic concentration in the sample because of the sublimation of the arsenic from the soil. As a result the -200 mesh material from sample RR-546 from Step 15 was sampled for analysis at ATI. This result will probably be more representative of the -200 mesh material.

- The +8 mesh material was coned and quartered following crushing and prior to pulverizing in order to expedite sample submittal to the lab for analysis. This resulted in about 250 grams of material being pulverized. Large samples of the -8 mesh material were also coned and quartered prior to pulverizing to expedite sample submittal. The reduction of sample size during this process should not impact the analytical result obtained for the particular sieve size because the soil is more uniform following crushing and splitting of the sample and is likely to include equal ratios of each grain size.

D.3.2 Chemical Testing

A total of 130 soil samples were submitted to ATI for total arsenic analysis. Since each sample was dried prior to screening and collecting the sample, the analytical results were reported on a wet weight basis. The differences between the treatability study and RI laboratory methods were compared. The treatability study and RI samples were prepared using SW-846 Method 3050 and, according to the QAPP in the Site Management Plan, analyzed by graphite furnace/atomic absorption (SW-846 Method 7060). This is a similar method used by ATI for all RI arsenic analyses. This is not the method used for the treatability studies performed by Hazen Research. Hazen used an American Society for Testing of Materials (ASTM) Method D 4606-86 which used a slightly more rigorous extraction procedure than was used by ATI. This may have resulted in the Hazen method extracting different amounts of arsenic from each soil sample relative to the amount extracted from a similar sample analyzed at ATI. Hazen used a hydride atomic absorption analysis method different from the graphite furnace analysis method used by ATI. We are unable to predict the impact that these differences may have on the analytical results without a detailed evaluation of these two analytical methods.

Two water samples were submitted to ATI for total arsenic analysis to determine potential dissolution of arsenic during the wet screening process. Samples were analyzed using SW-846 Method 7060, the same analytical procedure used when analyzing the soil samples.

D.3.3 Treatability Study Results

The results of the physical and chemical analysis for the Grid and NGRR soils are presented in Attachment D-1. Table D-2 presents the mean arsenic distribution and cumulative mean arsenic distribution with respect to grain size for both grid samples and railroad samples. A total of 7 samples (2 Hazen, 5 Hart Crowser) were analyzed to assess the arsenic distribution with respect to grain size in grid soil.

Grid Soil: Evaluation of the data generated during the analysis of grid soil is summarized below.

- For the 7 samples analyzed, the average grain size distribution was 60.7% Gravel, 32.0% Sand, and 7.3% Silt. The mean arsenic concentration for each grain size is presented in Table D-2. Based on the data for all of the grid soil samples presented in Attachment D-1, the range of arsenic distribution by soil type is presented below.

Size Fraction	Range of Total Arsenic Distribution in %
+1/4-inch (gravel)	8.4 to 21.4
-1/4-inch to +200 mesh (sand)	28.4 to 55.7
-200 mesh (silt)	22.9 to 47.0

- The calculated pulverized whole sample arsenic concentration and the result for the pulverized whole sample analysis was compared for each sample (see Attachment D-1). The percent difference of these concentrations ranged from +50 percent (Area 18 - Hazen Sample) to -20.0 percent (18R-461). This level of accuracy is attributed to the high degree of variation expected with the high concentrations of arsenic in the matrix.

Narrow Gage Railroad (NGRR) Soil: Evaluation of the data generated during the analysis of NGRR soil are summarized below. A total of 6 samples (1 Hazen, 5 Hart Crowser) were analyzed to assess the arsenic distribution with respect to grain size in NGRR soil.

- For the 6 samples analyzed the average grain size distribution was 57% Gravel, 36.7% Sand, and 6.3% Silt. The mean arsenic concentration for each grain size is presented in Table D-2. Based on the data for the NGRR soil samples presented in Attachment D-1, the range of arsenic distribution by soil type is presented below.

Size Fraction	Range of Total Arsenic Distribution in %
+1/4-inch (gravel)	7.1 to 12.7
-1/4-inch to +200 mesh (sand)	22.0 to 70.7
-200 mesh (silt)	17.4 to 62.8

- The calculated pulverized whole sample arsenic concentration and the result of the pulverized whole sample analysis was compared for each sample (Attachment A). The percent difference of these concentrations ranged from +83 percent (RR-545) to -13 percent (RR-528). This level of accuracy is attributed to the high degree of variation expected with the high concentrations of arsenic in the matrix.

D.3.4 Conclusion

The application of soil washing may be effective when applied to Site soil impacted by arsenic. This treatability study shows that a coarser low concentration fraction and a finer high concentration fraction can be readily attained. The determination of the particle size "cut point" for impacted soils is likely to vary with the initial concentration of the feed soil. A lower "cut point" may be attained by implementing higher energy particle separation technologies, such as attrition scrubbing.

Table D-1 – Whole Samples Total Arsenic Results 250/500-Foot Grid and Narrow Gage Railroad Track

Sample Number	Total Arsenic Concentration in mg/kg		
	RI	Treatability Study	
	Whole Sample (ATI Result)	Whole Sample (ATI Result)	Pulverized Whole Sample (ATI Result)
250/500-Foot Grid			
LR-125E	110	71	34
LR-157	82	48	23
LR-207	140	54	31
LR-311	360	110	60
18R-461	100	74	35
Narrow Gage Railroad Track			
RR-515	550	370	220
RR-528	400	490	190
RR-536	480	550	120
RR-545	530	150	100
RR-546	950	340	81

TABLE D-2 - ARSENIC DISTRIBUTION WITH GRAIN SIZE
ARSENIC TREATABILITY STUDY
FORMER DUPONT WORKS SITE

AVERAGE ARSENIC DISTRIBUTION IN GRID SAMPLES

Screen Size	Mean Dist. in Percent by weight		Mean Conc. in mg/kg	Cumulative Mean Conc. in mg/kg*
+1	18.0%			
-1+1/2	26.0%	Gravel	7.46	7.46
-1/2+1/4	16.7%		8.67	8.26
	60.7%		9.87	8.68
-1/4+8m	8.7%			
-8m+16m	4.5%		17.24	9.86
-16m+30m	5.0%	Sand	30.45	11.23
-30m+60m	7.6%		45.66	13.43
-60m+100m	3.6%		58.21	17.19
-100m+200m	2.5%		84.05	20.01
	32.0%		120.47	22.50
-200m	7.3%	Silt		
	7.3%		181.90	32.44
	100.0%			

AVERAGE ARSENIC DISTRIBUTION IN NGRR SAMPLES

Screen Size	Mean Dist. in Percent by weight		Mean Conc. in mg/kg	Cumulative Mean Conc. in mg/kg*
+1	18.0%			
-1+1/2	21.5%	Gravel	21.15	21.15
-1/2+1/4	17.5%		32.06	28.26
	57.0%		49.45	35.25
-1/4+8m	11.8%			
-8m+16m	5.4%		81.37	43.13
-16m+30m	7.5%	Sand	110.35	47.96
-30m+60m	7.8%		158.45	57.68
-60m+100m	2.3%		249.18	74.72
-100m+200m	1.9%		602.18	88.47
	36.7%		876.61	105.03
-200m	6.3%	Silt		
	6.3%		1,689.61	203.32
	100.0%			

* The cumulative mean concentration is the sum of the products of the weight percent and the concentration divided by the cumulative coarser weight percents.

ATTACHMENT D-1
WET SCREENING PROCESS DATA FOR HART CROWSER AND HAZEN RESEARCH ARSENIC TREATABILITY STUDIES

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
18R-461	+1"	35.6		6.5		16.6
	-1"+1/2"	26.2	gravel	9.0		16.9
	-1/2"+1/4"	11				0.0
		72.8			6.4	33.5
	-1/4"+8m	5.5				0.0
	-8m+10m	0.7				0.0
	-10m+16m	2.3				0.0
	-16m+30m	4.8	sand			0.0
	-30m+60m	6.6				0.0
	-60m+100m	2.3				0.0
	-100m+200m	1.8		160.0		20.6
		24			12.0	20.6
	-200m	3.2	silt/clay	200.0		45.9
		3.2			200.0	45.9
	Total	100.0	TOTAL		14.0	100.0

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	74

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
LR-125E	+1"	13.9		6.0		#DIV/0!
	-1"+1/2"	28	gravel	9.0		33.8
	-1/2"+1/4"	20.3				0.0
		62.2			5.4	67.0
	-1/4"+8m	9.6				0.0
	-8m+10m	0.9				0.0
	-10m+16m	2.2				0.0
	-16m+30m	2.7	sand			0.0
	-30m+60m	7.2				0.0
	-60m+100m	5.1				0.0
	-100m+200m	2.8		90.0		41.3
		30.5			8.3	41.3
	-200m	7.3	silt/clay	160.0		91.7
		7.3			160.0	91.7
	Total	100.0				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	71

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
LR-157	+1"	13.9		7.2		
	-1"+1/2"	33.6	gravel	7.1		
	-1/2"+1/4"	18.4				
		65.9				
	-1/4"+8m	8.2				
	-8m+10m	1.2				
	-10m+16m	2.4				
	-16m+30m	3.8	sand			
	-30m+60m	6.5				
	-60m+100m	2.8				
	-100m+200m	2.8		100.0		
		27.7				
	-200m	6.4	silt/clay	120.0		
	Total	100.0				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	48

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
LR-207	+1"	9.9		5.8		
	-1"+1/2"	21.2	gravel	6.1		
	-1/2"+1/4"	13				
		44.10				
	-1/4"+8m	9.8				
	-8m+10m	2.3				
	-10m+16m	4.6				
	-16m+30m	9.4	sand			
	-30m+60m	12.2				
	-60m+100m	3.4				
	-100m+200m	3		89.0		
		44.7				
	-200m	11.2	silt/clay	120.0		
	Total	100.00				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	54

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
LR-311	+1"	13.8		16.0		
	-1"+1/2"	22.8	gravel	9.3		
	-1/2"+1/4"	16.7				
		53.30				
	-1/4"+8m	10.5				
	-8m+10m	1.1				
	-10m+16m	3.4				
	-16m+30m	6.1	sand			
	-30m+60m	10				
	-60m+100m	4.4				
	-100m+200m	3.9		200.0		
		39.4				
	-200m	7.3	silt/clay	300.0		
	Total	100.0				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	110

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
RR-528	+1"	21.3		15.0		
	-1"+1/2"	19.6	gravel	36.0		
	-1/2"+1/4"	18.7				
		59.60				
	-1/4"+8m	11.3				
	-8m+10m	1.1				
	-10m+16m	3.6				
	-16m+30m	7.8	sand			
	-30m+60m	9.8				
	-60m+100m	2.4				
	-100m+200m	2.8		1500.0		
		38.8				
	-200m	1.6	silt/clay	1800.0		
			slime/water	0.32 mg/l		
	Total	100.00				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	490

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
RR-536	+1"	22.2		23.0		
	-1"+1/2"	22.2	gravel	50.0		
	-1/2"+1/4"	16.3				
		60.70				
	-1/4"+8m	10.9				
	-8m+10m	1.2				
	-10m+16m	3.1				
	-16m+30m	4.7	sand			
	-30m+60m	6.2				
	-60m+100m	2.4				
	-100m+200m	2.1		610.0		
		30.6				
	-200m	8.7	silt/clay	1200.0		
	Total	100.0				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1- gal before crushing	550

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
RR-545	+1"	14		11.0		
	-1"+1/2"	22.7	gravel	26.0		
	-1/2"+1/4"	21				
		57.7				
	-1/4"+8m	11				
	-8m+10m	1.1				
	-10m+16m	2.9				
	-16m+30m	4.7	sand			
	-30m+60m	7.9				
	-60m+100m	3.5				
	-100m+200m	3.3		700.0		
		34.4				
	-200m	7.9	silt/clay	1100.0		
			slime/water	0.41 mg/l		
	Total	100.0				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	150

FORMER DUPONT WORKS SITE
J-3534-14
TREATABILITY STUDY
Revised : 14-Mar-02
WET SCREENING DATA FOR ARSENIC

Sample Identification	Screen Size	Distribution Wt. %	Solids Classification	Assay mg/kg	Arsenic Calculate Head, mg/	Distrib. %
RR-546	+1"	23.5		18.0		
	-1"+1/2"	22.6	gravel	24.0		
	-1/2"+1/4"	14.3				
		60.4				
	-1/4"+8m	10.5				
	-8m+10m	1.5				
	-10m+16m	4.2				
	-16m+30m	8.5	sand			
	-30m+60m	8				
	-60m+100m	1.3				
	-100m+200m	0.9		790.0		
		34.9				
	-200m	4.7	silt/clay	1600.0		
	Total	100.0				

Sample Identification	Total As mg/kg
Pulverized Head A	
Whole sample; 1-gal before crushing	340

APPENDIX E – *RANKING OF ALTERNATIVES*

Chapter 6 defines the performance of the alternatives against the alternatives screening criteria (effectiveness, implementability, and cost). Ranking of these alternatives using these criteria was conducted. All members of the FS project team independently ranked the alternatives and the results were compiled into a single ranking for each alternative. A semi-quantitative comparative method was adopted whereby each participant gave each alternative a score of "-2" for very poor "-1" for poor, "0" for average, "+1" for good or "+2" for very good performance according to a given criterion. The score of each participant was normalized to bring each person's average criterion ranking to "0" prior to compiling the results into a single ranking for each alternative and criterion. The comparative analysis allows the evaluation of all the alternatives against the single screening criterion. This allows the ranking mechanism to be used to assess the best and least favorable alternative for the particular criterion. Table E-1 summarizes the compiled results using weighting factors that place equal emphasis on each effectiveness criterion, implementability, and cost.

Different weighting factors were applied to the three screening criteria to examine the sensitivity of the ranking results as preference is given to different screening criteria. Four different weighting factor scenarios were applied to the alternatives to assess relative performance. These four scenarios emphasize the following criteria preferences.

- **Equal:** Effectiveness, implementability, and cost carry the same weight.
- **Favoring Cost:** Effectiveness and implementability are the same weight while cost carries twice the weight.
- **Favoring Effectiveness:** Implementability and cost have the same weight while effectiveness has five times the weight.
- **Favoring Effectiveness and Cost:** Effectiveness carries a total weight of five, one for each sub-criterion, cost carries a weight of three, and implementability carry a weight of two.

The sensitivity of ranking results to the weighting factor set used is presented in Table E-2.

The weighting of the screening criteria had a small effect on the overall ranking of the alternatives. The alternatives were close in each case and the highest ranked alternatives ranked high following the application of different weightings. The ranking of alternatives did not directly influence the selection of alternatives for further analysis. The ranking was performed as a preliminary step in the screening process and was only used as guidance. Table E-3 illustrates this point.

Table E-1 - Screening of Alternatives

Alternative	EFFECTIVENESS: Protection of Human Health and the Environment	EFFECTIVENESS: Compliance with ARARs	EFFECTIVENESS: Reduction of Toxicity Mobility and Volume	EFFECTIVENESS: Short Term Effectiveness	EFFECTIVENESS: Long Term Effectiveness	IMPLEMENTABILITY: Implementability	COST: Cost	SUM
No Action	-2	-2	-2	-1	-2	2	2	-5
Cover	0	0	0	0	-1	-1	1	-1
Capping	0	0	0	0	-1	-1	1	-1
Cap/Cover	0	1	0	0	0	0	0	1
On-site Deposition with Cap/Cover	1	2	0	0	1	1	1	6
Off-site Disposal at Landfill	2	2	2	-1	2	-1	-2	4
Soil Washing with chelants and offsite disposal	1	2	1	0	1	-1	-1	3
Soil Washing with acid and offsite disposal	1	2	1	-1	1	-2	-1	1
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	1	-2	2	-1	1	-1	-1	-1
Wet Screening, Classification and Disposal at Landfill	2	2	1	-1	2	-1	-2	3
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	1	2	1	1	1	0	0	6

Score
-2 Very Poor
-1 Poor
0 Average
1 Good
2 Very Good

Retained for further analysis

Table E-2 - Weighting Factors Used for Ranking of Alternatives

Former DuPont Works Site
DuPont, Washington

	Effectiveness					Implementability	Cost
Emphasis of Weighting Factors	Protection of Human Health and the Environment	Compliance with ARARs	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Long-Term Effectiveness	Implementability	Cost
Equal Weighting for Effectiveness, Cost, and Implementability	0.2	0.2	0.2	0.2	0.2	1	1
Favoring Cost	0.1	0.1	0.1	0.1	0.1	0.5	1
Favoring Effectiveness	1	1	1	1	1	1	1
Favoring Effectiveness and Cost	1	1	1	1	1	2	3

Table E-3 - Comparative Analysis of Alternatives Using Selected Weighting Factors

Weighting: 0.2, 0.2, 0.2, 0.2, 0.2, 1, 1 **Equal**	WEIGHTED SCORE
No Action	2.2
Cover	-0.2
Capping	-0.2
Cap/Cover	0.2
On-site Deposition with Cap/Cover	2.8
Off-site Disposal at Landfill	-1.6
Soil Washing with chelants and offsite disposal	-1
Soil Washing with acid and offsite disposal	-2.2
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	-1.8
Wet Screening, Classification and Disposal at Landfill	-1.8
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	1.2

Weighting: 0.1, 0.1, 0.1, 0.1, 0.1, 0.5, 1 **Favoring cost**	WEIGHTED SCORE
No Action	2.1
Cover	0.4
Capping	0.4
Cap/Cover	0.1
On-site Deposition with Cap/Cover	1.9
Off-site Disposal at Landfill	-1.8
Soil Washing with chelants and offsite disposal	-1
Soil Washing with acid and offsite disposal	-1.6
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	-1.4
Wet Screening, Classification and Disposal at Landfill	-1.9
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	0.6

Weighting: 1, 1, 1, 1, 1, 1, 1 **Favoring effectiveness**	WEIGHTED SCORE
No Action	-5
Cover	-1
Capping	-1
Cap/Cover	1
On-site Deposition with Cap/Cover	6
Off-site Disposal at Landfill	4
Soil Washing with chelants and offsite disposal	3
Soil Washing with acid and offsite disposal	1
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	-1
Wet Screening, Classification and Disposal at Landfill	3
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	6

Weighting: 1, 1, 1, 1, 1, 2, 3 **Favoring effectiveness and cost**	WEIGHTED SCORE
No Action	1
Cover	0
Capping	0
Cap/Cover	1
On-site Deposition with Cap/Cover	9
Off-site Disposal at Landfill	-1
Soil Washing with chelants and offsite disposal	0
Soil Washing with acid and offsite disposal	-3
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	-4
Wet Screening, Classification and Disposal at Landfill	-2
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	6

APPENDIX F – *COST ESTIMATE FOR REMEDIAL ALTERNATIVES ANALYZED IN DETAIL*

This appendix describes the procedures used in estimating capital costs. The estimating process generally follows the guidance provided by EPA for CERCLA sites, *Remedial Action Costing Procedures Manual*, although the Site is not being administered under the EPA CERCLA process. This guidance was selected as being appropriate because of the number of constituents identified during the RI.

F.1 Capital Cost

Capital costs are those costs that are incurred during the construction and implementation of the cleanup action. These include: unit price for each process element (e.g., excavation, treatment, disposal); engineering design; contingency allowance; construction oversight; administration; and community relations. Direct and indirect capital costs were developed separately since several of the indirect costs are estimated as a percentage of the direct costs.

F.1.1 Direct Capital Costs

The direct capital costs include estimates of the construction, implementation, and disposal costs. These costs were gathered from vendors who provided budgetary estimates based on specific Site information generated from the RI and the treatability studies. In general, the vendors responded with a range of costs that may be applicable for the remedial action of Site soils. The average low and high vendor unit cost estimates are presented in Table F-1. The variability between the low and high cost was expected since the vendors were not asked to provide a bid for services, which in many cases would require a pilot study or bench-scale treatability studies on Site soils.

Using the unit costs presented in Table F-1, estimated costs were assembled by summing the unit costs for each activity that are combined to comprise each alternative. Table F-2 presents an activity-by-activity cost estimate and a low and high total and overall direct costs for each of the alternatives analyzed in detail in Section 6.0. These estimates of remedial action cost are assumed to be accurate to within -30 percent and +30 percent of the estimate where both estimates could vary by –30 to +30 percent of the listed value. In effect, the estimated "Best Estimate" remedial action cost would be defined as average of the high and low estimate.

Several assumptions, listed below, were necessary to complete the direct capital cost estimates:

- Estimate of soil volumes is based on RI and ISR data, which are assumed to be accurate and complete;
- Cleanup or remediation levels for all constituents are assumed;
- Estimate of soil volumes was conducted according to the procedures and assumptions described in Section 3.0, and are the basis for the direct cleanup action costs; and
- Direct costs are based on the technology unit costs developed from vendor solicitation, engineering estimation, treatability study results, and past experience with similar technologies.

EPA guidance also recommends that the direct cost estimates include the estimated costs for equipment, land and site development needed to implement the cleanup action, buildings and services, and relocation costs. These costs were not included in the estimated direct cost for the following reasons:

- **Equipment**. At this time we anticipate that the remedial action will be done as by a contractor to Weyerhaeuser or DuPont. Subsequently, the cost for the purchase of equipment will likely be small in relation to the total cleanup action cost.

- **Land and Site Development**. Expenses associated with the preparation of the Site prior to implementing the remedial action are likely to be small in relation to the total cleanup action cost.

- **Buildings and Services Cost**. Buildings used by the contractors during interim source removal will again be utilized by the remedial action contractor, and no new facilities are anticipated. Services including electricity, garbage, sewer, and other utilities, which are not included in the unit cost of the remedial alternative, will be small in relation to the total action cost. The unit costs presented in Table F-1 are assumed to include the costs associated with this direct cost.

F.1.2 Indirect Capital Costs

Indirect capital costs are those costs associated with engineering design, contingency, construction oversight, administration, and community relations. These costs were estimated based on previous experience during interim source removal and the remedial investigation of the Site. Tables F-3 presents a breakdown of the estimated indirect costs by alternative.

The following assumptions were incorporated into the estimates for indirect cost for each alternative:

- Implementation will be directly related to the amount of soils handling;

- Engineering design costs are estimated at 5 percent of the direct costs;

- Construction oversight costs are estimated at 10 percent of the direct costs;

- Administrative and reporting costs are estimated at 3 percent of the direct costs;

- Contingency allowances are estimated at 25 percent of the direct costs; and

- Four public meetings may be held during the design, construction, operation, and closure of the selected cleanup action. The costs of this effort are estimated at 1 percent of the direct costs.

The following assumptions for developing indirect costs were also developed and are applicable to each remediation unit and remedial alternative:

- Construction oversight is provided by a third party contractor;

- Community relations will be provided by company representatives and a third party contractor; and

- Ecology oversight, administration, and public meeting costs are not included in the estimated costs.

EPA guidance also recommends that the license and permitting costs be included. These costs were not included in the estimated indirect capital cost since obtaining permits for remediation activities under a state cleanup action is not required. The cleanup must otherwise conform to the substantive requirements of the regulation.

F.2 Total Estimated Cost

The preceding cost estimates are the basis for the estimated total cost for all remediation units of the Site. The sum of the direct costs and indirect costs are presented for each remediation alternative in Table F-4. The range of low and high total costs represent the range of direct costs and the corresponding contingency and engineering design ranges which are based on a percentage of the direct costs. Costs for the remediation of Miscellaneous Small RUs are listed on Table F-5.

Based on the preferred alternatives presented in Chapter 8 for remediation of in-place and stockpiled Site soils, and the completed interim source removal described in Chapter 1, the best estimate of total cost for Site remediation was prepared and is presented in Table F-6. Including accrued costs for studies, sampling, legal fees, and communications etc., the total cost of Site remediation is approximately $64,000,000.

Table F-1 – High and Low Range Estimated Costs

TABLE F-1 - HIGH AND LOW RANGE ESTIMATED UNIT COSTS
FORMER DUPONT WORKS SITE

Remedial Action Process Or Technology	High Cost Estimate	Low Cost Estimate	Unit Type
COVER (>3 FT. OF SOIL)	$2.50	$1.50	($/SF)
CAPPING	$4.50	$2.75	($/SF)
CAP/COVER	$1.25	$0.75	($/SF)
EXCAVATION	$5.00	$2.25	($/CY)
DRY SCREENING	$15.00	$7.50	($/TON)
WET SCREENING	$40.00	$22.00	($/TON)
SOIL CLASSIFICATION	$125.00	$50.00	($/TON)
ACID EXTRACTION	$150.00	$110.00	($/TON)
CHELANT EXTRACTION	$150.00	$100.00	($/TON)
IN-PLACE STABILIZATION	$250.00	$150.00	($/CY)
STABILIZATION USING RCC	$80.00	$40.00	($/CY)
EXCAVATED STABLIZATION AND PLACEMENT	$100.00	$40.00	($/CY)
EXCAVATED STABILIZATION ONLY	$75.00	$20.00	($/CY)
BACKFILL EXCAVATION	$5.00	$5.00	($/CY)
BACKFILL CLEAN FRACTION	$5.00	$5.00	($/CY)
GOLF COURSE COSTS	$0.70	$0.51	($/SF)
TRANSPORT OFF-SITE	$6.00	$6.00	($/TON)
OFF-SITE DISPOSAL AS PROBLEM	$80.00	$55.50	($/TON)
OFF-SITE DISPOSAL AS DANGEROUS	$136.00	$99.00	($/TON)
RECYCLING AT ASPHALT PLANT OR CEMENT KILN	$42.00	$35.00	($/TON)
PRECIPITATION OF METAL SOLUTION	$5.00	$5.00	($/GALLON)
RECYCLING AT SMELTER	$600.00	$400.00	($/TON)

TABLE F-2 - ESTIMATED LOW AND HIGH RANGE DIRECT COSTS
FORMER DUPONT WORKS SITE
DUPONT, WASHINGTON

LOW RANGE UNIT COSTS ALTERNATIVE	APPROX. TOTAL COST	COVER	CAPPING	CAP/COVER	EXCAVATE	WET SCREENING	SOIL CLASS.	ACID EXTRACT.	CHELANT EXTRACT.	STABILIZE USING RCC	Added Cost SOIL COVER	TRANSPORT OFF-SITE	OFF-SITE DISP/HAZ W/ STAB	PRECIP. OF METAL SOLUTION
		$1.50	$2.75	$0.75	$2.25	$22.00	$50.00	$110.00	$100.00	$40.00	$0.51	$6.00	$108.90	$5.00
	($)	($/SF)	($/SF)	($/SF)	($/CY)	($/TON)	($/TON)	($/TON)	($/TON)	($/CY)	($/SF)	($/TON)	($/TON)	($/GALLON)
No Action	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cover	$30,000,000	$30,004,128	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capping	$55,000,000	$0	$55,007,568		$0	$0	$0	$0	$0		$0	$0	$0	$0
Cap/Cover	$15,000,000	$0		$15,002,064	$0	$0	$0	$0	$0		$0	$0	$0	$0
On-site Deposition with Cap/Cover	$9,200,000	$0		$2,940,300	$1,723,925	$0	$0	$0	$0		$4,000,000	$0	$584,066	$0
Off-site Disposal at Landfill	$125,900,000	$0	$0	$0	$2,643,577	$0	$0	$0	$0	$0	$0	$6,435,988	$116,813,175	$0
Soil Washing with chelants and offsite disposal	$52,300,000	$0	$0	$0	$1,723,925	$23,598,621	$0	$0	$10,726,646		$0	$643,599	$11,681,317	$3,930,945
Soil Washing with acid and offsite disposal	$53,400,000	$0			$1,723,925	$23,598,621	$0	$11,799,311	$0		$0	$643,599	$11,681,317	$3,930,945
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$32,400,000	$0	$0	$0	$1,723,925	$23,598,621	$0	$0	$0	$3,064,756	$4,000,000			$0
Wet Screening, Classification and Disposal at Landfill	$43,000,000	$0	$0	$0	$1,723,925	$23,598,621	$5,363,323	$0	$0	$0	$0	$643,599	$11,681,317	$0
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$41,600,000	$0	$0	$0	$1,723,925	$23,598,621	$0	$0	$0		$4,000,000	$643,599	$11,681,317	$0

HIGH RANGE UNIT COSTS ALTERNATIVE	APPROX. TOTAL COST	COVER	CAPPING	CAP/COVER	EXCAVATE	WET SCREENING	SOIL CLASS.	ACID EXTRACT.	CHELANT EXTRACT.	STABILIZE USING RCC	Added Cost SOIL COVER	TRANSPORT OFF-SITE	OFF-SITE DISP/HAZ W/ STAB	PRECIP. OF METAL SOLUTION
		$2.50	$4.50	$1.25	$5.00	$40.00	$125.00	$150.00	$150.00	$80.00	$0.70	$6.00	$149.60	$5.00
	($)	($/SF)	($/SF)	($/SF)	($/CY)	($/TON)	($/TON)	($/TON)	($/TON)	($/CY)	($/SF)	($/TON)	($/TON)	($/GALLON)
No Action	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Cover	$50,000,000	$50,006,880	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Capping	$90,000,000	$0	$90,012,384		$0	$0	$0	$0	$0		$0	$0	$0	$0
Cap/Cover	$28,800,000	$0		$25,003,440	$3,830,945	$0	$0	$0	$0		$0	$0	$0	$0
On-site Deposition with Cap/Cover	$15,000,000	$0		$4,900,500	$3,830,945	$0	$0	$0	$0		$5,500,000	$0	$802,353	$0
Off-site Disposal at Landfill	$172,800,000	$0	$0	$0	$5,874,615	$0	$0	$0	$0	$0	$0	$6,435,988	$160,470,624	$0
Soil Washing with chelants and offsite disposal	$83,400,000	$0			$3,830,945	$42,906,584	$0	$0	$16,089,969		$0	$643,599	$16,047,062	$3,930,945
Soil Washing with acid and offsite disposal	$83,400,000	$0			$3,830,945	$42,906,584	$0	$16,089,969	$0		$0	$643,599	$16,047,062	$3,930,945
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$58,400,000	$0	$0	$0	$3,830,945	$42,906,584	$0	$0	$0	$6,129,512	$5,500,000			$0
Wet Screening, Classification and Disposal at Landfill	$76,800,000	$0	$0	$0	$3,830,945	$42,906,584	$13,408,308	$0	$0	$0	$0	$643,599	$16,047,062	$0
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$68,900,000	$0	$0	$0	$3,830,945	$42,906,584	$0	$0	$0		$5,500,000	$643,599	$16,047,062	$0

TABLE F-3 - ESTIMATED LOW AND HIGH RANGE INDIRECT COSTS
FORMER DUPONT WORKS SITE
DUPONT, WASHINGTON

LOW RANGE COSTS BY ALTERNATIVE	APPROX. DIRECT COSTS ($)	APPROX. DESIGN COSTS 5%	APPROX. PUBLIC RELATIONS 1%	APPROX. CONSTRUCTION OVERSIGHT 10%	APPROX. ADMIN. & REPORTING 3%	APPROX. TOTAL CONTINGENCY 25%	APPROX. TOTAL INDIRECT COSTS	APPROX. TOTAL COSTS
No Action	$0	$0	$0	$0	$0	$0	$0	$0
Cover	$14,600,000	$730,000	$146,000	$1,460,000	$438,000	$3,650,000	$6,424,000	$21,024,000
Capping	$55,000,000	$2,750,000	$550,000	$5,500,000	$1,650,000	$13,750,000	$24,200,000	$79,200,000
Cap/Cover	$17,500,000	$875,000	$175,000	$1,750,000	$525,000	$4,375,000	$7,700,000	$25,200,000
On-site Deposition with Cap/Cover	$8,400,000	$420,000	$84,000	$840,000	$252,000	$2,100,000	$3,696,000	$12,096,000
Off-site Disposal at Landfill	$126,900,000	$6,345,000	$1,269,000	$12,690,000	$3,807,000	$31,725,000	$55,836,000	$182,736,000
Soil Washing with chelants and offsite disposal	$53,000,000	$2,650,000	$530,000	$5,300,000	$1,590,000	$13,250,000	$23,320,000	$76,320,000
Soil Washing with acid and offsite disposal	$54,000,000	$2,700,000	$540,000	$5,400,000	$1,620,000	$13,500,000	$23,760,000	$77,760,000
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$33,000,000	$1,650,000	$330,000	$3,300,000	$990,000	$8,250,000	$14,520,000	$47,520,000
Wet Screening, Classification and Disposal at Landfill	$43,700,000	$2,185,000	$437,000	$4,370,000	$1,311,000	$10,925,000	$19,228,000	$62,928,000
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$42,300,000	$2,115,000	$423,000	$4,230,000	$1,269,000	$10,575,000	$18,612,000	$60,912,000

HIGH RANGE COSTS BY ALTERNATIVE	APPROX. TOTAL DIRECT COSTS ($)	APPROX. DESIGN COSTS 5%	APPROX. PUBLIC RELATIONS 1%	APPROX. CONSTRUCTION OVERSIGHT 10%	APPROX. ADMIN. COSTS 3%	APPROX. TOTAL CONTINGENCY 25%	APPROX. TOTAL INDIRECT COSTS	APPROX. TOTAL COSTS
No Action	$0	$0	$0	$0	$0	$0	$0	$0
Cover	$18,600,000	$930,000	$186,000	$1,860,000	$558,000	$4,650,000	$8,184,000	$26,784,000
Capping	$90,000,000	$4,500,000	$900,000	$9,000,000	$2,700,000	$22,500,000	$39,600,000	$129,600,000
Cap/Cover	$14,100,000	$705,000	$141,000	$1,410,000	$423,000	$3,525,000	$6,204,000	$20,304,000
On-site Deposition with Cap/Cover	$12,900,000	$645,000	$129,000	$1,290,000	$387,000	$3,225,000	$5,676,000	$18,576,000
Off-site Disposal at Landfill	$174,200,000	$8,710,000	$1,742,000	$17,420,000	$5,226,000	$43,550,000	$76,648,000	$250,848,000
Soil Washing with chelants and offsite disposal	$84,400,000	$4,220,000	$844,000	$8,440,000	$2,532,000	$21,100,000	$37,136,000	$121,536,000
Soil Washing with acid and offsite disposal	$84,400,000	$4,220,000	$844,000	$8,440,000	$2,532,000	$21,100,000	$37,136,000	$121,536,000
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$59,300,000	$2,965,000	$593,000	$5,930,000	$1,779,000	$14,825,000	$26,092,000	$85,392,000
Wet Screening, Classification and Disposal at Landfill	$77,800,000	$3,890,000	$778,000	$7,780,000	$2,334,000	$19,450,000	$34,232,000	$112,032,000
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$69,900,000	$3,495,000	$699,000	$6,990,000	$2,097,000	$17,475,000	$30,756,000	$100,656,000

TABLE F-4 - ESTIMATED LOW AND HIGH RANGE TOTAL COSTS
FORMER DUPONT WORKS SITE
DUPONT, WASHINGTON

	LOW RANGE BY ALTERNATIVE	HIGH RANGE BY ALTERNATIVE	"BEST ESTIMATE" BY ALTERNATIVE
	TOTAL COST	TOTAL COST	TOTAL COST
	($)	($)	($)
No Action	$0	$0	$0
Cover	$43,200,000	$72,000,000	$57,600,000
Capping	$79,200,000	$129,600,000	$104,400,000
Cap/Cover	$21,600,000	$41,472,000	$31,536,000
On-site Deposition with Cap/Cover	$13,248,000	$21,600,000	$17,424,000
Off-site Disposal at Landfill	$181,296,000	$248,832,000	$215,064,000
Soil Washing with chelants and offsite disposal	$75,312,000	$120,096,000	$97,704,000
Soil Washing with acid and offsite disposal	$76,896,000	$120,096,000	$98,496,000
Wet Screening with Stabilization, On Site Deposition, Cap/Cover	$46,656,000	$84,096,000	$65,376,000
Wet Screening, Classification and Disposal at Landfill	$61,920,000	$110,592,000	$86,256,000
Wet Screening, On-site Deposition, Cap/Cover and Off-Site Disposal	$59,904,000	$99,216,000	$79,560,000

Table F-5 – Estimated Low and High Remediation Costs for Miscellaneous Small Remediation Units

Type	Low Cost	High Cost	"Best" Cost
Similar Mixtures	$ 63,370	$ 63,926	$ 68,833
Similar Deposition	$ 63,370	$ 63,926	$ 68,833
Single Contaminant	$ 63,370	$ 63,926	$ 68,833
"Hot Spots"	$ 636,965	$ 642,550	$ 691,876
Debris	$ 759,684	$ 766,344	$ 825,174
Sequalitchew Creek NGRR	$ 633,704	$ 639,259	$ 688,333
Total	$ 2,220,635	$ 2,240,103	$ 2,411,884

Table F-6 – Summary of Site Remediation Costs

Item	Best Estimate of Cost in $
Proposed Remediation in this FS[1]	17,424,000
Miscellaneous Small Units	$ 2,411,884
Source Removal Costs Accrued[2]	$46,000,000
Costs for Studies, Sampling, Legal, Communications, etc. Accrued[2]	$7,300,000
Total Cost of Site Remediation	$73,135,884

[1]Based on the preferred alternatives for remediation presented in Section 8.0 and costs in Appendix F.
[2]Actual cost through December 31, 2001.

APPENDIX G – *ESTIMATION OF MINIMUM SOIL VOLUME REQUIRED FOR COST-EFFECTIVE ON-SITE TREATMENT*

To estimate the minimum soil volume required for treatment on Site, the remediation cost per unit volume (CY) was plotted as a function of soil volume for high, low, and average cleanup action cost options as presented on Figure G-1.

G.1 Assumptions

- The high cost option is based on a high treatment cost of $200/CY and disposal as hazardous waste at $180/ton. The low cost option is based on a low treatment cost $90/CY and disposal as problem waste at $61.50/ton.

- Mobilization and demobilization costs were assumed to be $50,000 for the low cost option and $100,000 for the high cost option. These costs are based on ranges provided by vendors for stabilization and soil washing.

- All options include engineering design (12%) and contingency (25%) (10% engineering design and contingency are included in the off-Site disposal costs to account for costs of stockpile management and uncertainty in volume of impacted soil to be disposed of). Long-term maintenance and monitoring cost are not included.

- The average cost treatment is simply the arithmetic average of the high and low cost treatments.

G.2 Conclusion

- If a soil can be characterized as problem waste, direct disposal at an industrial landfill is the best option.

- If the soil is hazardous, it becomes cost-effective to treat the soil with an average cost treatment when the volume is greater than approximately 5,000 CY.

- If the equipment has already been mobilized on Site for other impacted soils, and the mobilization cost does not need to be included in the cost per CY, then average cost treatment is always more cost-effective than disposal as hazardous waste.

Sensitivity of Remediation Costs to Volume of Soil Treated

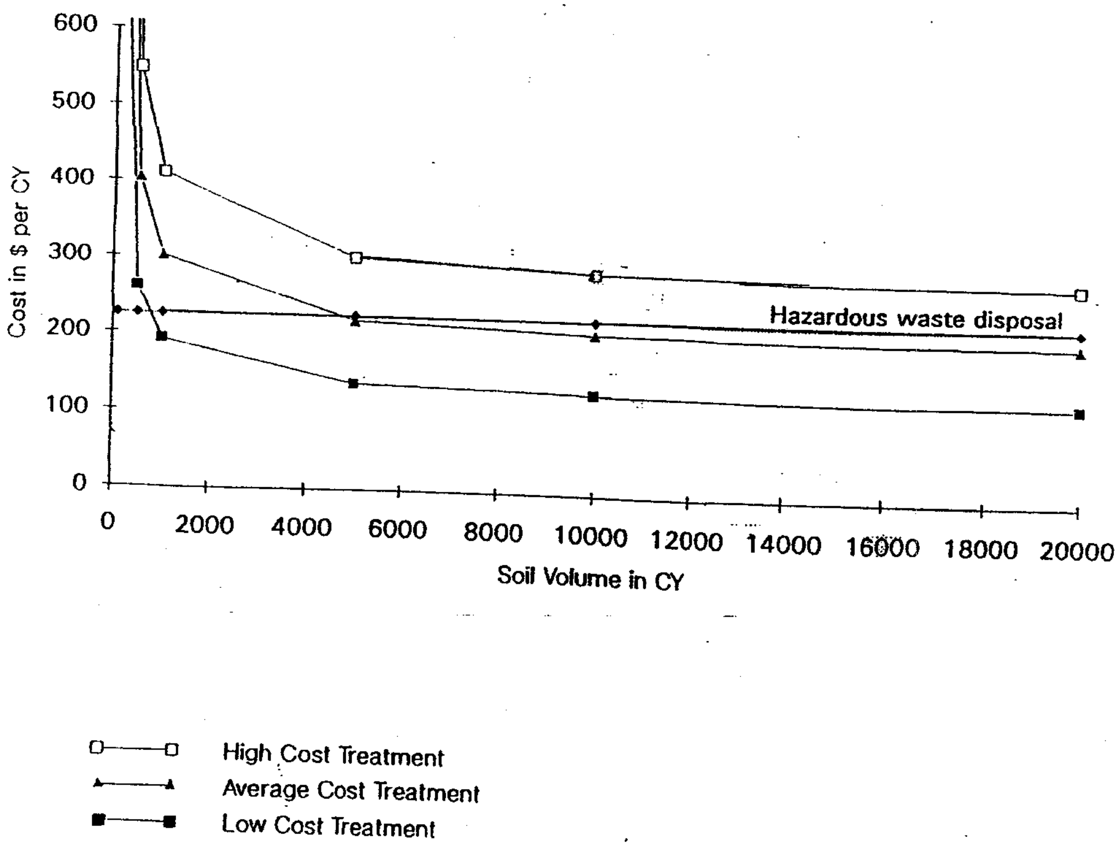

Figure G-1